Kindly add the following new claim 33:

33. An ultrasonic motor according to claim 1; wherein the support member comprises a pair of support members disposed on opposite sides of the piezoelectric vibrator.

D4

ADDITIONAL FEES:

A check in the amount of $18.00 is enclosed to cover the cost of one additional claim in excess of those already paid for. Should the check prove insufficient for any reason, authorization is hereby given to charge any such deficiency to our Deposit Account No. 01-0268.

REMARKS

By this amendment, independent claim 1 has been amended in a broadening respect by replacing the claim limitation reciting a "pair of support members with --a support member--. New claim 33 has been added to replace canceled claim 23 and dependent claims 24 and 26 have been amended to depend from claim 33. Marked-up versions of the amended claims are attached hereto.

As described below, the minor amendment made to claim 1 herein is not believed to affect the Examiner's finding of patentability of claim 1.

The present invention relates to an ultrasonic motor having improved vibration efficiency. As pointed out by applicants at pages 1-2 of the specification, a conventional ultrasonic motor utilizes an elastic member to resiliently bias a piezoelectric element against a moving member to efficiently transmit a drive power due to oscillation of the piezoelectric element to the movable member. The conventional ultrasonic motor relies upon the expansion-and-contraction and flexural vibration of the piezoelectric element to drive the movable member and uses signal lines to transmit drive signals from a circuit board to the piezoelectric element.

The conventional ultrasonic motor is typically installed on a circuit board by means of a support member which holds the piezoelectric element to the circuit board, and signal transmission extends between the circuit board and the piezoelectric element for applying a drive signal to the piezoelectric element.

As further noted by applicants, the use of the support member, the signal transmission wires and the elastic member results in a significant loss in expansion-and-contraction and flexural vibration of the piezoelectric element. Thus, the general structure of the conventional ultrasonic motor lends to inefficient transmission of drive force from the piezoelectric element to the moving member and impairs the electric-to-mechanical energy conversion.

The present invention provides an ultrasonic motor with a reduced loss in the drive force produced by a piezoelectric element so that the drive force is efficiently transmitted to a moving member, and facilitates a size reduction and improvement in reliability by eliminating unnecessary components from the motor.

In accordance with one aspect of the present invention recited by independent claim 1, the ultrasonic motor comprises a movable member disposed to undergo movement in response to a drive force, a substrate having a conductor pattern for conveying a drive signal from a drive circuit, a piezoelectric vibrator provided on the substrate for undergoing oscillating movement in response to the drive signal so as to contact the movable member and thereby generate the drive force for driving the movable member, and a support member provided on the substrate for mechanically supporting the piezoelectric vibrator on the substrate and transmitting the drive signal from the conductor pattern to electrodes of the piezoelectric vibrator.

By the structure recited in claim 1, the support member serves the dual function of supporting the piezoelectric element and transmitting the drive signal from the conductor pattern to the piezoelectric element. As a result, there is no need for conductor wires extending from

the substrate to connect the drive circuit and the piezoelectric vibrator, and vibration loss is reduced.

A significant aspect of the invention recited by independent claim 1 is that the piezoelectric element of the ultrasonic motor undergoes oscillating movement in response to the drive signal so as to contact the movable member and thereby generate the drive force for driving the movable member. The prior art of record fails to disclose this subject matter of claim 1.

As noted above, the conventional piezoelectric ultrasonic motor utilizes an elastic member for biasing the piezoelectric element in contact with the movable member and conductive wires for conveying a drive signal produced by a drive circuit to the piezoelectric element. The use of separate components to accomplish these tasks leads to an increase in the size of the ultrasonic motor and a loss in the expansion-and-contraction and flexural vibration of the piezoelectric element.

The present invention recited by claim 1 overcomes these problems by providing an ultrasonic motor in which a piezoelectric element directly contacts a movable member in response to oscillation thereof and drives the movable member. The claimed invention also eliminates the need for separate conductor wires and a support member by providing a support

member capable of serving as a conductive path. According to the present invention, the support member not only supports the piezoelectric element on a substrate, but also has the ability to transmit a drive signal to the piezoelectric element so that no conductor wires are needed.

Thus, in accordance with the present invention, a piezoelectric element comes into and out of direct contact with a movable member to cause the movable member to undergo movement. The prior art of record does not disclose or suggest this aspect of the invention.

The support member is preferably formed of a resilient material or has a flexible portion so that it resiliently urges the piezoelectric element against the movable member, thereby eliminating the need for a separate elastic member to bias the piezoelectric element and movable member. Accordingly, the present invention makes it possible to substantially reduce the size of the ultrasonic motor and reduces the loss associated with the use of multiple components as described above.

Claim 1 is not anticipated by Katsuma, Miyazawa or Vishnevsky '580 or rendered obvious by Miyazawa, Vishnevsky '580 and Katsuma. None of these references discloses an ultrasonic motor in which a piezoelectric element comes into contact with a movable member to drive the movable member as recited by independent claim 1.

For instance, Vishnevsky '580 discloses a piezoelectric motor having a stator 1 and a rotor 3. The stator 1 has a housing 7 and a piezoelectric oscillator 6 mounted to the housing 7. The piezoelectric oscillator 6 has a piezoelectric cell 9 with electrodes 13 and pushers 10, each pusher 10 having one end secured to one flat surface of the piezoelectric cell 9 so that a gap 14 is provided between the piezoelectric cell 9 and the pusher 10. The other end of each pusher 10 rests against the rotor 3.

Accordingly, Vishnevsky '580 fails to disclose a piezoelectric element provided on a substrate for undergoing oscillating movement in response to the drive signal <u>so as to contact the movable member</u> and thereby generate the drive force for driving the movable member. In Vishnevsky '580, elastic members, or pushers 10, are interposed between the piezoelectric cell 9 and the rotor to convert the vibratory movement of the piezoelectric cell 9 into rotary movement of the rotor 3.

Miyazawa discloses structure similar to that of Vishnevsky '580. For example, in the ultrasonic motor illustrated in Fig. 7 of Miyazawa, a piezoelectric element 3-1 is formed on a bottom surface of a stator 2-1. A rotor 1-1 has projections 1a-1 extending therefrom. The projections 1a-1 are disposed on a top surface of the stator 2-1. The

piezoelectric element 3-1 is formed on the bottom surface of the stator 2-1 and never contacts the rotor 1-1. Thus, Miyazawa does not disclose a piezoelectric element provided on a substrate for undergoing oscillating movement in response to the drive signal <u>so as to contact the movable member</u> and thereby generate the drive force for driving the movable member as required by claim 1.

The ultrasonic motor of Katsuma is similar to that of Vishnevsky '580 and Miyazawa and the reference does not disclose a piezoelectric element that comes into contact with a movable member as required by independent claim 1.

Nor do the references disclose or suggest a substrate having a conductor pattern for conveying a drive signal from a drive circuit, a piezoelectric vibrator provided on the substrate, and a support member for supporting the piezoelectric vibrator and transmitting the drive signal to the piezoelectric vibrator as required by claims 1 and 20. Nothing in the cited references would have suggested this combination of elements.

Since Vishnevsky '580, Miyazawa and Katsuma fail to identically disclose the subject matter recited by independent claim 1, the claims are not anticipated.

Nor do the cited references suggest any modifications needed to replicate the claimed invention. As

described above, the ultrasonic motor of claim 1 has a piezoelectric element that comes into contact with a movable member and that is provided with a support member that transmits a drive signal to the piezoelectric element so that no conductive wires are needed. The inventive ultrasonic motor of these claims has an improved driving force, a reduced vibrational loss and smaller dimensions as compared with conventional ultrasonic motors. In the Fig. 1 embodiment, the piezoelectric vibrator 10 generates a rotational driving force in response to a received drive signal. A drive signal for driving the piezoelectric element 10 is transmitted along leads 7 to a support member 11. The support member 11 supports, and is in electrical connection with, the piezoelectric vibrator 10 on the substrate 8. Thus, the support member is effective for both supporting the piezoelectric member 10 and for transmitting the drive signal from a conductor pattern formed on the substrate to the piezoelectric vibrator 10. The movable member 12 contacts the piezoelectric vibrator 10 and moves in response to the vibrational driving force. There is simply no teaching or motivation in the references for making any of the modifications necessary to achieve the claimed combination. Thus, there is no support for an obviousness rejection of claim 1.

In view of the foregoing amendments and discussion, the application is now believed to be in condition for allowance. Accordingly, favorable consideration and allowance of amended claim 1 and all other pending claims are most respectfully requested.

Respectfully submitted,

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MAILING CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: Commissioner of Patents & Trademarks, Washington, D.C. 20231, on the date indicated below.

Bruce L. Adams
Attorney Name

____
Signature

APRIL 15, 2002
Date

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 1, 24 and 26 have been amended as follows:

1. (Four Times Amended) An ultrasonic motor, comprising: a movable member disposed to undergo movement in response to a drive force; a substrate having a conductor pattern for conveying a drive signal from a drive circuit; a piezoelectric vibrator provided on the substrate for undergoing oscillating movement in response to the drive signal so as to contact the movable member and generate the drive force to drive the movable member; and a [pair of support members disposed on the substrate on opposite sides of the piezoelectric vibrator] <u>support member provided on the substrate</u> for mechanically supporting the piezoelectric vibrator on the substrate and transmitting the drive signal from the conductor pattern to electrodes of the piezoelectric vibrator so that no conductor wires extend from the substrate to connect the drive circuit and the piezoelectric vibrator.

24. (Twice Amended) An ultrasonic motor according to claim [1;] <u>33;</u> wherein the support members have an L-shaped form, one leg of each support member is fixedly attached to the substrate, and another leg of each support member is fixedly attached to the piezoelectric element.

26. (Twice Amended) An ultrasonic motor according to claim [1;] 33; wherein the support members each have an I-shaped form with upper and lower portions having a larger width than a middle portion, the lower portion of each support member is fixedly attached to the substrate, and the upper portion of each support member is fixedly attached to the piezoelectric element.